



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/648,953	08/26/2003	Sean S. Kang	LAM1P177/P1139	4068
22434	7590	10/05/2004	EXAMINER	
BEYER WEAVER & THOMAS LLP			MALDONADO, JULIO J	
P.O. BOX 778			ART UNIT	
BERKELEY, CA 94704-0778			PAPER NUMBER	
			2823	

DATE MAILED: 10/05/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/648,953

Applicant(s)

KANG ET AL.

Examiner

Julio J. Maldonado

Art Unit

2823

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 July 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) 13 and 18-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-12, 14-17 and 21-25 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of claims 1-12, 14-17 and 21-25 in the reply filed on 07/09/2004 is acknowledged.

Claim Objections

2. Claim 25 is objected to because of the following informalities: where applicants recite, "...which is different than the first etch chemistry..." should recite --which is different than the first etch recipe--. Appropriate correction is required.

Claim Rejections - 35 USC § 102

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1 and 21 are rejected under 35 U.S.C. 102(e) as being anticipated by Chung et al. (U.S. 6,750,150 B2).

Chung et al. (Figs.1-3B) teach a method of patterning a metal layer (110) deposited on a substrate (100) comprising providing said substrate (100); depositing said metal layer (110); forming a photoresist layer; patterning said photoresist layer to form a photoresist patterns (130), wherein said photoresist patterns (130) includes sidewalls with a first critical dimension; depositing a conformal layer (150) on the sidewalls of said photoresist patterns and on the surface of said metal layer (110); anisotropically etching said conformal layer (150) to form conformal layer spacers on

the sidewalls of said photoresist patterns (130), reducing the space between said photoresist patterns (130); and etching said metal layer (110) underlying said photoresist patterns (130) and conformal layer spacers forming metal patterns, wherein the space between said metal patterns is lower than said space between said photoresist patterns (column 2, line 54 – column 4, line 34).

Since the same materials are treated the same way, it is inherent from the teachings of Chung et al. that the photoresist patterns of Chung et al. have a first critical dimension, and that the addition of conformal layer spacers reduce the critical dimension of said photoresist patterns, resulting in metal patterns with a second critical dimension, which is less than a first critical dimension, thus arriving at the same result of the claimed invention.

4. Claim 21 is rejected under 35 U.S.C. 102(b) as being anticipated by Yang (U.S. 5,296,410).

Yang (Figs.4-7) teaches an etching method including the steps of placing a conductive layer (20) on a substrate (10); forming a mask, wherein the mask defines a plurality of mask lines (30) with mask spaces between the mask lines (30), wherein the mask spaces have a width and wherein the mask lines (30) have a width and have sidewalls; depositing a conformal layer (50) over the sidewalls of the mask lines (30); etching the conductive layer (20) through the mask lines (30) to form conductive lines (40) and spacers (50a) between the conductive lines (40), wherein the conductive lines (40) have a width and the spaces between the conductive lines (40) have widths, wherein the widths of the spaces between the conductive lines (40) is less than the

widths of the mask line spaces, and wherein the widths of the conductive lines (40) is greater than the widths of the line masks (30) (column 3, line 54 – column 4, line 55).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 2-6, 9-12 and 14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chung et al. (U.S. 6,750,150 B2) in view of Kinoshita et al. (U.S. 6,780,708 B1) and Ahn et al. (U.S. 6,740,977 B2).

In reference to claims 2-4, 10, 11 and 14-16, Chung et al. (Figs.1-3B) teach a method of patterning a metal layer (110) deposited on a substrate (100) comprising providing said substrate (100); depositing said metal layer (110); forming a photoresist layer; patterning said photoresist layer to form a photoresist patterns (130), wherein said photoresist patterns (130) includes sidewalls with a first critical dimension; depositing a conformal layer (150) on the sidewalls of said photoresist patterns and on the surface of said metal layer (110); anisotropically etching said conformal layer (150) to form conformal layer spacers on the sidewalls of said photoresist patterns (130), reducing the space between said photoresist patterns (130); and etching said metal layer (110) underlying said photoresist patterns (130) and conformal layer spacers forming metal patterns, wherein the space between said metal patterns is lower than said space between said photoresist patterns (column 2, line 54 – column 4, line 34).

Since the same materials are treated the same way, it is inherent from the teachings of Chung et al. that the photoresist patterns of Chung et al. have a first critical dimension, and that the addition of conformal layer spacers reduce the critical dimension of said photoresist patterns, resulting in metal patterns with a second critical dimension, which is less than a first critical dimension, thus arriving at the same result of the claimed invention.

Furthermore, Chung et al. teach wherein said conformal layer is made from organic or inorganic materials using plasma enhanced chemical vapor deposition (PECVD) or low pressure chemical vapor deposition (LPCVD) (Chung et al. column 3, lines 21 – 26), but fail to teach wherein depositing said material comprises a first deposition with a first gas chemistry to form a first deposition plasma; and a second deposition with a second gas chemistry to form a second deposition plasma, wherein the first gas chemistry is different than the second gas chemistry. However, Kinoshita et al. (Figs.1-6) in a related method to form metal pattern teach the steps of forming a metal layer (18) on a substrate (12); forming a mask layer (34a) on the metal layer (18); and forming a conformal layer spacer (46d) on the sidewalls of said mask layer (34a), wherein said conformal layer spacer (46d) is made from a material selected from the group including silicon oxide, silicon nitride and other nitrides. Furthermore, Kinoshita et al. teach silicon oxide layers and silicon nitride layers can be deposited using processes selected from the group including PECVD and atomic layer deposition (ALD) (column 8, line 44 – column 10, line 15).

It would have been within the scope of one of ordinary skill in the art to combine the teachings of Chung et al. and Kinoshita et al. to enable forming the conformal layer of Chung et al. according to the teachings of Kinoshita et al. because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of forming the conformal layer of Chung et al. and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

Furtherstill, Ahn et al. teach depositing a silicon nitride and boron nitride films using remote plasma ALD rather than conventional ALD in order to improve resistance of the layers against moisture, wherein said remote plasma ALD (column 1, lines 55 – 61 and column 2, line 35 – column 4, line 29).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Chung et al., Kinoshita et al. and Ahn et al. to enable forming the conformal layer of Chung et al. and Kinoshita et al. according to the process described in Ahn et al. since this would provide resistance to moisture and because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of forming the disclosed conformal layer of the combination of Chung et al. and Kinoshita et al. and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

Still, the combined teachings of Chung et al., Kinoshita et al. and Ahn et al. substantially teach all aspects of the invention but fail to disclose wherein the second

critical dimension is not greater than 60% of first critical dimension, and wherein the conformal layer has a sidewall thickness and a photoresist feature bottom thickness, wherein the sidewall thickness is greater than the photoresist feature bottom thickness. Notwithstanding, it would have been an obvious matter of design choice bounded by well known manufacturing constraints and ascertainable by routine experimentation and optimization to choose these particular dimensions because applicant has not disclosed that the dimensions are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical, and it appears prima facie that the process would possess utility using another dimension. Indeed, it has been held that mere dimensional limitations are prima facie obvious absent a disclosure that the limitations are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical. See, for example, *In re Rose*, 220 F.2d 459, 105 USPQ 237 (CCPA 1955); *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984); *In re Dailey*, 357 F.2d 669, 149 USPQ 47 (CCPA 1966).

In reference to claims 5 and 17, the combined teachings of Chung et al., Kinoshita et al. and Ahn et al. teach wherein the depositing the conformal layer over the sidewalls forms substantially vertical sidewalls (Chung et al., Figs.3A).

In reference to claims 6 and 12, the combined teachings of Chung et al., Kinoshita et al. and Ahn et al. substantially teach all aspects of the invention but fail to disclose wherein the photoresist layer is formed from 248 nm photoresist and feature has a CD no greater than 140 nm. Notwithstanding, it would have been an obvious

matter of design choice bounded by well known manufacturing constraints and ascertainable by routine experimentation and optimization to choose these particular dimensions because applicant has not disclosed that the dimensions are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical, and it appears prima facie that the process would possess utility using another dimension. Indeed, it has been held that mere dimensional limitations are prima facie obvious absent a disclosure that the limitations are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical. See, for example, *In re Rose*, 220 F.2d 459, 105 USPQ 237 (CCPA 1955); *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984); *In re Dailey*, 357 F.2d 669, 149 USPQ 47 (CCPA 1966).

In reference to claim 9, the combined teachings of Chung et al., Kinoshita et al. and Ahn et al. teach wherein the conformal layer has a sidewall thickness, and wherein the conformal layer has substantially the same sidewall thickness from a top to a bottom of the feature (Chung et al., Fig.3).

7. Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chung et al. (U.S. 6,750,150 B2) in view of Kinoshita et al. (U.S. 6,780,708 B1) and Ahn et al. (U.S. 6,740,977 B2) as applied to claims 1-6, 9-12 and 14-17 above, and further in view of Yamamoto et al. (U.S. 4,151,034).

The combined teachings of Chung et al., Kinoshita et al. and Ahn et al. substantially teach all aspects of the invention but fail to disclose stripping the

photoresist mask and deposited conformal layer with a single stripping step, wherein said stripping comprises ashing the photoresist mask and the deposited layer.

However, Yamamoto et al. teach a method of simultaneously etch a photoresist layer and a silicon nitride layer using ashing (column 1, lines 7 – 17). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Chung et al., Kinoshita et al. and Ahn et al. with the teachings of Yamamoto to enable the etching step of Chung et al., Kinoshita et al. and Ahn et al. to be performed according to the teachings of Yamamoto et al. because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of performing the disclosed etching step of Chung et al., Kinoshita et al. and Ahn et al. and art recognized suitability for an intended purpose has been recognized to be motivation to combine (MPEP 2144.07.), and furthermore, because this etching technique provide easier operation, higher reliability and no environmental pollution compared to conventional etching processes (Yamamoto et al., column 1, lines 7 – 17).

8. Claims 22-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chung et al. (U.S. 6,750,150 B2) as applied to claims 1 and 21 above, and further in view of the following comments.

Chung et al. substantially teach all aspects of the invention but fail to disclose wherein a ratio of the widths of the mask lines to the widths of the mask spaces is less than 1:1 and wherein a ratio of the widths of the conductive lines to the widths of the spaces between the conductive lines is not less than 1:1 or greater than 1:1; and

Art Unit: 2823

wherein the width of the mask spaces is more than 50% greater than the widths of the spaces between the conductive lines. However, the selection of the above-mentioned width spaces is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species to obtain a desired pattern. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the above-mentioned ratios to arrive at the claimed invention.

9. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yang (U.S. 5,296,410) as applied to claim 21 above, and further in view of the following comments.

Yang teaches etching the conformal layer and the conductive layer, sequentially, wherein in the etching process, the conformal layer and the conductive layer have an etching selectivity of about 10 to 1, for stable pattern formation (column 4, lines 24 – 36). Yang fails to teach wherein the etching of the conductive layer uses a second etch recipe, which is different than the first etch recipe. However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to etch with different etch recipes to obtain two etching processes with the selectivity described in Yang, thus arriving at the claimed invention.

Conclusion

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Julio J. Maldonado whose telephone number is (571) 272-1864. The examiner can normally be reached on Monday through Friday.


Art Unit: 2823

11. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (571) 272-1855. The fax number for this group is 703-872-9306 for before final submissions, 703-872-9306 for after final submissions and the customer service number for group 2800 is (703) 306-3329.

Updates can be found at <http://www.uspto.gov/web/info/2800.htm>.

Julio J. Maldonado
Patent Examiner
Art Unit 2823

Julio J. Maldonado
September 7, 2004


George Fourson
Primary Examiner